

WHAT IS CLAIMED IS:

1. A method for coating a fluid-handling part with an erosion-resistant coating, comprising the steps of:

providing a coating composition for the erosion-resistant coating comprising a trifunctional silane, a silanol fluid, and a filler,

applying said coating composition to the fluid-handling part; and,

curing said coating composition on the fluid-handling part to form the erosion-resistant coating, wherein

the erosion-resistant coating provides protection against erosion by particle impact, impingement, and cavitation for the fluid-handling part.

2. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said silanol fluid, in an essentially pure state, having a kinematic viscosity from about 40,000 centistokes to about 130,000 centistokes.

3. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said silanol fluid comprising a hydroxyl-terminated polydimethylsiloxane.

4. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said trifunctional silane selected from the group consisting of an acetoxysilane, a ketoximino silane, an enoxy silane, an amine silane, an alkoxy silane, and an alkenyl silane.

5. The method for coating a fluid-handling part with an erosion-resistant coating of claim 4,

said trifunctional silane selected from the group consisting of ethyl triacetoxysilane and vinyl triacetoxysilane.

6. The method for coating a fluid-handling part with an erosion-resistant coating of claim 4,

said trifunctional silane selected from the group consisting of methyl tris (methyl-ethyl-ketoximino) silane and vinyl tris (methyl-ethyl-ketoximino) silane.

7. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said filler selected from the group consisting of fumed silica, glass fiber, mica, wollastonite, kaolin, and phylosilicate.

8. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1, wherein

said trifunctional silane comprises from about 0.01 wt.% to about 20 wt.% of said coating composition on the basis of non-solvent components,

said silanol fluid comprises from about 40 wt.% to about 99 wt.% of said coating composition on the basis of non-solvent components, and further comprising

fumed silica in an amount of from about 0.01 wt.% to about 25 wt.% of said coating composition on the basis of non-solvent components.

9. The method for coating a fluid-handling part with an erosion-resistant coating of claim 8, wherein

said trifunctional silane is selected from the group consisting of an acetoxysilane and a ketoximino silane,

said trifunctional silane comprises from about 1.5 wt.% to about 10 wt.% of said coating composition on the basis of non-solvent components,

said silanol fluid comprises from about 60 wt.% to about 95 wt.% of said coating composition on the basis of non-solvent components, and further comprising

fumed silica in an amount of from about 3 wt.% to about 13 wt.% of said coating composition on the basis of non-solvent components.

10. The method for coating a fluid-handling part with an erosion-resistant coating of claim 9, wherein

said trifunctional silane is selected from the group consisting of ethyl triacetoxysilane and vinyl triacetoxysilane,

said trifunctional silane comprises from about 2 wt.% to about 7 wt.% of said coating composition on the basis of non-solvent components,

said silanol fluid comprises from about 85 wt.% to about 92 wt.% of said coating composition on the basis of non-solvent components, and further comprising

fumed silica in an amount of from about 5 wt.% to about 10 wt.% of said coating composition on the basis of non-solvent components.

11. The method for coating a fluid-handling part with an erosion-resistant coating of claim 9, wherein

said trifunctional silane is selected from the group consisting of methyl tris (methyl-ethyl-ketoximino) silane and vinyl tris (methyl-ethyl-ketoximino) silane,

said trifunctional silane comprises from about 2 wt.% to about 7 wt.% of said coating composition on the basis of non-solvent components,

said silanol fluid comprises from about 85 wt.% to about 92 wt.% of said coating composition on the basis of non-solvent components, and further comprising

fumed silica in an amount of from about 5 wt.% to about 10 wt.% of said coating composition on the basis of non-solvent components.

12. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said filler comprising fumed silica, wherein

the molar ratio of trifunctional silane to silanol is from about 5 to 1 to about 1000 to 1 and

the molar ratio of fumed silica to silanol is from about 10 to 1 to about 1000 to 1.

13. The method for coating a fluid-handling part with an erosion-resistant coating of claim 12, wherein

the molar ratio of trifunctional silane to silanol is from about 20 to 1 to about 300 to 1 and,

the molar ratio of fumed silica to silanol is from about 100 to 1 to about 300 to 1.

14. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1, further comprising:

providing an epoxy primer composition;

applying said primer composition to the fluid-handling part; and,

curing said primer composition on the fluid-handling part before applying said coating composition.

15. The method for coating a fluid-handling part with an erosion-resistant coating of claim 14,

said epoxy primer composition comprising an epoxy blend, an aliphatic amine, and a silane adhesion promoter selected from the group consisting of a trimethoxysilane, a triethoxysilane, and 3-glycidoxypropyl trimethoxysilane.

16. The method for coating a fluid-handling part with an erosion-resistant coating of claim 14, further comprising

preparing a surface of the fluid-handling part by

cleaning said surface of all foreign matter,

grit blasting said surface, and

removing residual dust with a blowgun,

wherein said preparing step is completed less than eight hours before applying said primer composition to the fluid-handling part.

17. The method for coating a fluid-handling part with an erosion-resistant coating of claim 14, wherein

said primer composition has a dry film thickness of from about 20 μm to about 80 μm .

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18. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1,

said applying comprising spraying.

19. The method for coating a fluid-handling part with an erosion-resistant coating of claim 18, wherein

said coating composition is sprayed using high-volume, low-pressure spraying equipment using a cup pressure of from about 15 psi to about 30 psi and an air pressure of from about 35 psi to about 50 psi.

20. The method for coating a fluid-handling part with an erosion-resistant coating of claim 18, wherein

said coating composition is sprayed using airless spraying equipment.

21. The method for coating a fluid-handling part with an erosion-resistant coating of claim 20, wherein

said coating composition is sprayed using airless spraying equipment using a pressure of from about 3000 psi to about 3300 psi.

22. The method for coating a fluid-handling part with an erosion-resistant coating of claim 1, wherein

said coating composition is applied to have a dry film thickness of from about 200 to about 3000 μm .

23. The method for coating a fluid-handling part with an erosion-resistant coating of claim 22, wherein

said coating composition is applied to have a dry film thickness of from about 500 to about 1000 μm .

24. The method for coating a fluid-handling part with an erosion-resistant coating of claim 18,

said spraying comprising

initially transferring said coating composition to form an initial layer having a dry film thickness of from about 70 μm to about 100 μm on the fluid-handling part;

allowing said initial layer to essentially fully cure;

subsequently transferring said coating composition to form a subsequent layer having a dry film thickness of less than about 500 μm on the fluid-handling part; and,

allowing said subsequent layer to cure, wherein

said initial layer and said subsequent layer have a total dry film thickness of from about 200 μm to about 600 μm .

25. The method for coating a fluid-handling part with an erosion-resistant coating of claim 24,

said spraying further comprising

repeating said subsequently transferring and said allowing said subsequent layer to cure to form at least two subsequent layers, wherein

said initial layer and said subsequent layers have a total dry film thickness of from about 200 μm to about 3000 μm .

26. A method for using an erosion-resistant coating comprising

providing a coating composition comprising a trifunctional silane, a silanol fluid, and a filler,

applying said coating composition to a fluid-handling part; and,

curing said coating composition on the fluid-handling part to form the erosion-resistant coating, wherein

the erosion-resistant coating provides protection against particle impact, cavitation, and impingement for the fluid-handling part.

27. The method for using an erosion-resistant coating of claim 26,

wherein the fluid-handling part is selected from the group consisting of a tank, a

pipe, a duct, a channel, a guide, an intake manifold, an aperture, a nozzle, and a jet deflector.

28. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a valve, a gate, a spear valve, and a spear tip.

29. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a turbine, a tide mill, a compressor, a pump, a windmill, and a blower.

30. The method for using an erosion-resistant coating of claim 29,
wherein the fluid-handling part comprises a hydroelectric turbine.

31. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of an impeller, a propeller, a fan, and a runner.

32. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a rotor, a bucket, a blade, and a vane.

33. The method for using an erosion-resistant coating of claim 32,
wherein the fluid-handling part comprises a helicopter rotor.

34. The method for using an erosion-resistant coating of claim 32,
wherein the fluid-handling part is selected from the group consisting of a turbine blade and a runner blade.

35. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part comprises a control surface, a wing, and a flap.

36. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a fairing,
a fuselage, and a dome.
37. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a housing,
a hub, and a shaft.
38. The method for using an erosion-resistant coating of claim 26,
wherein the fluid-handling part is selected from the group consisting of a
penstock, a spiral case, a strainer, and a draft tube.
39. The method for using an erosion-resistant coating of claim 26,
wherein a material forming a surface of the fluid-handling part is selected from
the group consisting of a metal, a ceramic, and a polymer.
40. The method for using an erosion-resistant coating of claim 26,
wherein a material forming a surface of the fluid-handling part is selected from
the group consisting of a steel alloy, a stainless steel alloy, an aluminum alloy, a nickel
alloy, a titanium alloy, a lead alloy, a urethane, an epoxy, a polycarbonate, an acrylic, a
polyester composite, and an epoxy composite.
41. The method for using an erosion-resistant coating of claim 40,
wherein a material forming a surface of the fluid-handling part is selected from
the group consisting of said steel alloy and said stainless steel alloy.
42. The method for using an erosion-resistant coating of claim 41, wherein the fluid-
handling part is a hydroelectric turbine.
43. An erosion-resistant fluid-handling part, comprising

a coating composition comprising a trifunctional silane, a silanol fluid, and a filler, cured on a surface of the fluid-handling part.

44. The erosion-resistant fluid-handling part of claim 43, wherein the fluid-handling part is a hydroelectric turbine.
45. The erosion-resistant fluid-handling part of claim 43, wherein a material forming the surface of the fluid-handling part is selected from the group consisting of a steel alloy and a stainless steel alloy.
46. The erosion-resistant fluid-handling part of claim 45, wherein the fluid-handling part is a hydroelectric turbine.
47. A method for maintaining protection of a fluid-handling part against erosion by particle impact, cavitation, or impingement comprising the steps of:
 - stripping an existing erosion-resistant coating from the fluid-handling part;
 - providing a coating composition comprising a trifunctional silane, a silanol fluid, and a filler,
 - applying said coating composition to the fluid-handling part; and,
 - curing said coating composition on the fluid-handling part.
48. The method for maintaining protection of a fluid-handling part against erosion by particle impact, cavitation, or impingement of claim 47,
 - said stripping comprising the step of
 - using a focused water jet to cut through and remove the existing erosion-resistant coating.
49. The method for maintaining protection of a fluid-handling part against erosion by particle impact, cavitation, or impingement of claim 47, further comprising the steps of
 - grit blasting to at least partially remove a primer;
 - providing a primer composition; and,

curing said primer composition on the fluid-handling part.

50. A method for repairing an erosion-resistant coating on a fluid-handling part, comprising the steps of:

preparing a surface of a damaged area by cleaning the surface of all foreign matter;

providing a coating composition for an erosion-resistant coating comprising a trifunctional silane, a silanol fluid, and a filler,

applying said coating composition to the surface of the damaged area; and,

curing said coating composition on the fluid-handling part.

51. The method for repairing an erosion-resistant coating on a fluid-handling part of claim 50, further comprising the steps of:

providing a mastic epoxy composition;

applying said mastic epoxy composition to the damaged area; and,

curing said mastic epoxy composition on the damaged area.